South Carolina Department of Health and Environmental Control

ENVIRONMENTAL AFFAIRS

SHELLFISH MANAGEMENT AREA 06A

2020 ANNUAL UPDATE

Shellfish Sanitation Section
Environmental Affairs
2600 Bull Street
Columbia, SC 29201

December 2020

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SHELLFISH MANAGEMENT AREA 06A
2020 ANNUAL UPDATE

[Data Through December 2019]

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Data Inclusive Dates:
01/01/17 thru 12/31/19

Classification Change:
___ Yes __N__ No

Shoreline Survey Completed: Yes

(I)ncreased/(D)ecreased/(N)one:
__N__ Approved
__N__ Conditionally Approved
__N__ Restricted
__N__ Prohibited

Prior Report & Date: 2019 Annual Update

SUMMARY

There will be no classification changes recommended within Shellfish Management Area 06A for the 2020-2021 shellfish harvesting season. Fecal coliform bacteriological data indicate that water quality within the estuary has continued to degrade during this review period. Water salinities are not typically very high in this growing area unless by the ocean inlets of the rivers, this is mostly due to freshwater inflows from the Santee River.

Due to major storm events such as Hurricane Dorian in 2019 and Hurricane Florence in 2018, major flooding occurred which caused freshwater input throughout Area 06A and salinity levels were extremely low during the end of 2018 and the beginning of 2019 which appeared to have impacts on bacteriological data.

During this review period only Station 06A-04 meets the classification for an Approved status for the upcoming harvesting season. Fecal coliform bacteriological data indicate that Shellfish Management Area 06A be classified as Restricted in all portions of the Atlantic Intracoastal Waterway (AIWW), North Santee River, and the South Santee River. The Approved Classification shall only be implemented seaward of Station 06A-04 in the North Santee Bay.

INTRODUCTION

PURPOSE AND SCOPE

The authority to regulate the harvest, sanitation, processing, and handling of shellfish is granted to the South Carolina Department of Health and Environmental Control by Section 44-1-140 of the Code of Laws of South Carolina, 1976, as amended. The Department promulgated Regulation 61-47 that provides the rules used to implement this authority and outlines the requirements applied in regulating shellfish sanitation in the State This regulation specifically addresses classification of shellfish harvesting areas and requires that all areas be examined by sanitary and bacteriological surveys and classified into an appropriate shellfish harvesting classification.

The National Shellfish Sanitation Program (NSSP) Guide For The Control Of Molluscan Shellfish is used by the United States Food and Drug Administration (USFDA) to evaluate state shellfish sanitation programs. The NSSP Model Ordinance requires that a sanitary survey be in place for each growing area prior to its use as a source of shellfish for human consumption and prior to the area's classification as Approved, Conditionally Approved, Restricted, or Conditionally Restricted. Each sanitary survey shall be updated on an annual basis and accurately reflect changes which have occurred within the area. Requirement of the annual reevaluation include, at a minimum, field observations of pollution sources, an analysis of water quality data consisting of the past year's data in combination with appropriate previously collected data, review of reports and effluent samples from pollution sources, and review of performance standards for discharges impacting the growing area. A brief report documenting the findings shall also be provided.

The following criteria consistent with the NSSP Model Ordinance and S. C. Regulation 61-47 are used in establishing shellfish harvesting classifications:

Approved Area - Growing areas shall be classified approved when the sanitary survey concludes that fecal material, pathogenic microorganisms, and poisonous or deleterious substances are not present in concentrations that would render shellfish unsafe for human consumption. Approved classifications shall be determined upon a sanitary survey that includes water samples collected from stations in the designated area adjacent to actual or potential sources of pollution. For waters sampled under adverse pollution conditions, the median fecal coliform Most Probable Number (MPN) or the geometric mean MPN shall not exceed fourteen per one hundred milliliters, nor shall more than ten percent of the samples exceed a fecal coliform MPN of forty-three per one hundred milliliters (per five tube decimal dilution). For waters sampled under a systematic random sampling plan, the geometric mean fecal coliform MPN shall not exceed fourteen per one hundred milliliters, nor shall the estimated ninetieth percentile exceed an MPN of forty-three per one hundred milliliters (per five tube decimal dilution). Computation of the estimated ninetieth percentile shall be determined using National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish methodology.

Conditionally Approved Area - Growing areas may be classified conditionally approved when they are subject to temporary conditions of actual or potential pollution. When such events are predictable, as in non-point source pollution from rainfall runoff or discharge of a major river, a management plan describing conditions under which harvesting will be allowed shall be adopted by the Department prior to classifying an area as conditionally approved. Where appropriate, the management plan for each conditionally approved area shall include performance standards for sources of controllable pollution (e.g., wastewater treatment and collection systems), evaluation of each source of pollution, and means of rapidly closing and subsequently reopening areas to shellfish harvesting. Memorandums of agreements shall be a part of these management plans where appropriate. Shellfish shall not be directly marketed from a conditionally approved area until conditions for an approved classification have been met for a period of time likely to ensure the shellfish are safe for consumption. Shellstock from conditionally approved areas that have been subjected to temporary conditions of actual or potential pollution may be relayed to approved areas for purification or depurated through controlled purification operations only by special permit issued by the Department.

Restricted Area - Growing areas shall be classified restricted when sanitary survey data show a moderate degree of pollution or the presence of deleterious or poisonous substances to a degree that may cause the water quality to fluctuate unpredictably or at such a frequency that a conditionally approved classification is not feasible. Shellfish may be harvested from areas classified as restricted only for the purposes of relaying or depuration and only by special permit issued by the Department and under Department supervision. The suitability of restricted areas for harvesting of shellstock for relay or depuration purposes may be determined through the use of comparison studies of background tissue samples with post-process tissue samples, as well as other process verification techniques deemed appropriate by the Department. For restricted areas to be utilized as a source of shellstock for depuration, or as source water for depuration, the fecal coliform geometric mean MPN of restricted waters sampled under adverse pollution conditions shall not exceed eighty-eight per one hundred milliliters nor shall more than ten percent of the samples exceed a MPN of two hundred and sixty per one hundred milliliters for a five tube decimal dilution test. For waters sampled under a systematic random sampling plan, the fecal coliform geometric mean MPN shall not exceed eighty-eight per one hundred milliliters nor shall the estimated ninetieth percentile exceed an MPN of two hundred and sixty (five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish methodology.

Conditionally Restricted Area - Growing areas may be classified conditionally restricted when they are subject to temporary conditions of actual or potential pollution. When such events are unpredictable, as in the malfunction of wastewater treatment facilities, non-point source pollution from rainfall runoff, discharge of a major river or potential discharges from dock or harbor facilities that may affect water quality, a management plan describing conditions under which harvesting will be allowed shall be prepared by the Department prior to classifying an area as conditionally restricted. Where appropriate, the management plan for each conditionally restricted area shall include performance standards for sources of controllable pollution, e.g., wastewater treatment and collection systems and an evaluation of each source of pollution, and description of the means of rapidly closing and subsequent reopening areas to shellfish harvesting. Memorandums of agreements shall be a part of these management plans where appropriate. Shellfish may be harvested from areas classified as conditionally restricted only for the purposes of relaying or depuration and only by permit issued by the Department and under Department supervision. For conditionally restricted areas to be utilized as a source of shellstock for depuration, the fecal coliform geometric mean MPN of conditionally restricted waters sampled under adverse pollution conditions shall not exceed eighty-eight per one hundred milliliters nor shall more than ten percent of the samples exceed an MPN of two hundred and sixty per one hundred milliliters for a five tube decimal dilution test. For waters sampled under a systematic random sampling plan, the fecal coliform geometric mean MPN shall not exceed eighty-eight per one hundred milliliters nor shall the estimated ninetieth percentile exceed an MPN of two hundred and sixty per one hundred milliliters (five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish methodology.

Prohibited Area - Growing areas shall be classified prohibited if there is no current sanitary survey report or if the sanitary survey report or monitoring data show unsafe levels of fecal material, pathogenic microorganisms, or poisonous or deleterious substances in the growing area

or otherwise indicate that such substances could potentially reach quantities that could render shellfish unfit or unsafe for human consumption.

BACKGROUND INFORMATION

Shellfish Management Area 06A (Area 06A) is comprised of the North and South Santee Rivers and North Santee Bay and their tributaries including Beach, Mosquito, Big Duck, Duck, Little Duck, Minim, Sand, and Cork Creeks. Other tributaries include Meadow, Kimloch, Sixmile, Pleasant, Montgomery, Hampton and Atchison Creeks. Fourmile Creek Canal connects the two rivers and Bird Bank Creek is tributary to the Atlantic Ocean. The southern boundary of the area is the South Santee River; the western boundary is the U.S. Highway 17 Bridge traversing the North and South Santee Rivers. Minim Creek Canal and portions of South and Cat Islands define the northern boundary. The eastern boundary is the Atlantic Ocean.

The harvesting classification for Area 06A prior to this sanitary survey was as follows:

Prohibited: None

Restricted:

1. All portions of the South Santee River, including all tributaries;
2. All portions of the North Santee River, including all tributaries;
3. All portions of the Intracoastal Waterway;
4. Portions of North Santee Bay upstream of Station 06A-04, including all tributaries.

Conditionally Approved: None

Approved: Those portions of North Santee Bay seaward of Station 06A-04.

The shellfish industry in South Carolina is based on harvest of the eastern oyster (*Crassostrea virginica*) and hard clams, which include both the northern clam (*Mercenaria mercenaria*) and several small populations of the southern clam (*Mercenaria campechiensis*). *C. virginica* have been harvested from Area 06A during the closed shellfish season for Culture Permit reseeding purposes. These relay projects have been jointly permitted and supervised by the South Carolina Department of Health and Environmental Control (SCDHEC) and the South Carolina Department of Natural Resources (SCDNR). SCDHEC has not granted approval for mechanical depuration or wet storage activities in Area 06A.

Area 06A is routinely evaluated by SCDNR in order to determine resource productivity. SCDNR uses the State shellfish ground designation for these commercial activities. SCDNR has identified a population of hard clams in the vicinity of Stations 06A-03, 06A-04, 06A-04A & 06A-04B. Resource harvest difficulties (subtidal, isolated) make illegal harvest activities unprofitable and therefore highly unlikely.

The shellfish harvesting season in South Carolina typically extends from October 1 through May 15. SCDNR has the authority to alter the shellfish-harvesting season for resource management purposes. Additionally, SCDHEC has the authority to prohibit shellfish harvesting when

necessary to ensure that shellfish harvested in South Carolina waters are safe for human consumption.

POLLUTION SOURCE SURVEY

SURVEY PROCEDURES

The South Carolina Department of Health and Environmental Control (SCDHEC) - Environmental Affairs, Pee Dee - Myrtle Beach, Shellfish Sanitation Staff conducted a shoreline survey of uplands immediately adjacent to Area 06A growing waters by watercraft during the survey period. Extensive visual examination of lands adjacent to the waters of Area 06A was conducted to determine potential sources of pollution entering shellfish growing waters. The Area 06A shellfish growing area (Santee River Delta) is an undeveloped area.

POINT SOURCE POLLUTION

A. **Municipal and Community Waste Treatment Facilities -** There are no wastewater treatment facilities located within the boundaries of Area 06A. The Town of Saint Stephens, approximately thirty miles upstream of Area 06A, has a National Pollutant Discharge Elimination System permit (SC0025259) with a rated flow limit of 0.450 MGD of treated effluent. Additionally, Georgetown County Water and Sewer's North Santee WWTP is located slightly upstream of the Area 06A boundary on the North Santee River. This small facility has a rated flow of 0.0520 MGD. Below is a chart summarizing any sanitary sewer overflows during this review period.

Sanitary Sewer Overflows

Georgetown County Water & Sewer North Santee WWTP (2017-2019)

Date	Location	Gallons	Water Body Entered	Comments
N/A	N/A	N/A	N/A	N/A

B. **Industrial Waste -** No industrial discharges are located within the boundaries of Area 06A.

C. **Marinas -** No marinas are located within Area 06A. In 2007, prompted by the Department's Office of Coastal Resource Management (OCRM) marina definition change, the Shellfish Sanitation Section incorporated the following marina definition. S.C. Regulation 61-47, Shellfish defines Marina as any of the following: (1) locked harbor facility; (2) any facility which provides fueling, pump-out, maintenance or repair services (regardless of length); (3) any facility which has effective docking space of greater than 250 linear feet or provides moorage for more than 10 boats; (4) any water area with a structure which is used for docking or otherwise mooring vessels and constructed to provide temporary or permanent docking space for more than ten boats, such as a mooring field; or (5) a dry stack facility.

D. **Radionuclides** - Sources of radionuclides have not been identified within Area 06A, and

radionuclide monitoring has not been conducted.

NONPOINT SOURCE POLLUTION

A. Urban and Suburban Stormwater Runoff - Stormwater runoff from construction activities can have a significant impact on water quality. As stormwater flows over a construction site, it can pick up pollutants like sediment, debris, and chemicals and transport these to a nearby storm sewer system or directly to a river, lake, coastal waterways, or shellfish growing area. SCDHEC Bureau of Water in coordination with the Office of Ocean and Coastal Resource Management ensure that land disturbance activities are permitted accordingly and utilize stormwater best management practices to ensure potential pollutants are not introduced into the environment and nearby water bodies.

Area 06A contains no urban development. A 1972 study (The Santee-Cooper River Basin Water Quality Management Plan) conducted by SCDHEC addressed problems associated with nonpoint source stormwater runoff in the Santee River basin upstream from Area 06A. The area described in that study consisted of drainage into the North and South Santee Rivers near the Atlantic Ocean. The study found that water quality problems consist primarily of fecal coliform bacteria contamination associated with a large number of nonpoint source discharges and a high prevalence of livestock and poultry operations.

Future studies related to rediversion impacts on the Santee River basin system may more fully assess and update these nonpoint source impacts on waters within the boundaries of Area 06A.

B. Agricultural Runoff - Agriculture within Area 06A is relatively sparse and non-existent. There are no permitted agricultural facilities located within the area.

C. Individual Sewage Treatment and Disposal (ISTD) Systems - Domestic dwellings are extremely sparse in Area 06A. Very few families reside on South and Cat Islands in association with the Tom Yawkey Wildlife Center. Additional structures include shop and maintenance facilities, four graduate student dormitories and a recreation hall. All structures are serviced by ISTD systems. All systems are located in areas of sandy soil. (Joyner, pers. comm.)

The Cane Island Hunt Club, a small hunting shack located on upper Cane Island, utilizes a privy system for infrequent use.

D. Wildlife and Domestic Animals - The Tom Yawkey Wildlife Center, which is utilized for waterfowl management/research, is comprised of approximately 4,325 acres of uplands, 6,235 acres of wetlands, 314 acres of beach, and 2,374 acres of impoundments and nontidal freshwater. Waterfowl are abundant especially during spring and autumn migrations. Throughout Area 6A there are numerous waterfowl impoundments both private and state managed to hold wintering waterfowl.

Area 06A and surrounding lands support natural populations of rabbit, white-tailed deer,

raccoon, opossum, alligators, rodents, songbirds and shorebirds typical of the coastal Carolinas. Populations of feral hogs and scrub goats in the salt marshes of the Santee delta and adjacent sea-islands represent probable sources of fecal coliform contamination. Domestic animal population in the area is sparse. Cattle and poultry farming operations exist along the shorelines of the Santee River upstream from Area 06A boundaries; however, specific inventories of these have not been developed as part of the current survey. Distance from shellfish stocks and dilution minimize impacts on the growing waters of the area.

E. **Boat Traffic** – There are no designated marinas located within the boundaries of Area 06A. Recreational boat traffic is light except for Atlantic Intracoastal Waterway (AIWW) travel during peak summer months. During spring and fall months sailboats and yachts routinely travel the AIWW mostly due to relocating the vessels around hurricane seasons.

F. **Hydrologic and Habitat Modification** - Historical changes have had major impacts on the habitat modification of the Santee delta. A serious shoaling problem developed in Charleston Harbor subsequent to the completion of the Santee-Cooper Diversion Project in 1942. The purpose of the project was to generate hydroelectric power and provide a navigation channel to the confluence of the Wateree and Congaree Rivers at Columbia, a distance of 105 miles. The project included a single lock and dam at Pinopolis (Lake Moultrie), a dam on the Cooper River and Spillway (Lake Marion), a dam on the Santee River, and a diversion canal between Lake Moultrie and Lake Marion. The diversion project increased the average flow in the Cooper River (Charleston) from 72 cubic feet per second (cfs) to 15,000 cfs and greatly increased dredging requirements in Charleston Harbor. (U.S. Army Corps of Engineers, 1983) As a result of this diversion, substantial oyster and clam recruitment occurred in the lower portions of Santee River system.

The Cooper River Rediversion Project, completed in August 1985, redirected approximately 80 percent of the fresh water from the Cooper River back into the Santee River. This redirection reduced freshwater inflow to the Cooper River from an average of 15,600 cfs to 3,000 cfs. The reduction in flow was projected to reduce shoaling in Charleston Harbor by 70 percent. (Federal Energy Regulatory Commission, 1981) Flow from Lake Marion Spillway, Saint Stephen hydroelectric generating station, and Lake Marion hydroelectric generating station reaches the lower Santee Rivers and surrounding waters of Area 06A approximately 72 hours from time of release. As expected, rediversion has had a major influence on the hydrography of the North and South Santee Rivers, as well as the portions of the AIWW southward (portions of Shellfish Management Areas 06B and 07) to the northern boundary of Shellfish Management Area 08 in the vicinity of Moores Landing. Recruitment of oyster and clam stocks has been substantially reduced subsequent to the rediversion project. (South Carolina Wildlife and Marine Resources Department, pers. comm.)

NATURALLY OCCURRING PATHOGENS

A. **Marine Biotoxins** - Bivalve shellfish contamination from marine biotoxins has not been shown to be a human health concern within Area 05. During the winter and spring of 1988,

South Carolina experienced an occurrence of "Red Tide", specifically Ptychodiscus brevis (K. brevis), which affected water quality in Areas 01 - 04. There have been no documented reoccurrences of this organism at levels requiring emergency response in South Carolina waters subsequent to the 1988 event. Due to the vast media coverage of events related to Pfiesteria pisicida, the Department participates in a State Task Group on Toxic Algae and operates a toxic algae emergency response team.

B. ***Vibrio parahaemolyticus*** – Because State water temperatures exceed 81 degrees Fahrenheit (F) during June through September; *Vibrio parahaemolyticus* (Vp) management controls must be implemented during these months. Management controls for permitted Aquaculture facilities are specifically addressed in R.61-47. The season for wild-stock harvest of oysters is currently closed from May 16 through September 16. Because R.61-47 does not specifically address control of wild-stock harvest from waters exceeding 81 degrees F, the Department will recommend to and request of SCDNR that the wild stock harvesting season not be opened until October 1. The Department is currently opposed to issuance of special wild-stock harvest permits to Certified Shippers during the closed season. Special permit conditions for maricultured triploid oysters during the vibrio control months must include current R.61-47 and NSSP temperature control requirements to be included in the Certified Shipper's HACCP plan.

HYDROGRAPHIC AND METEROLOGICAL CHARACTERISTICS

Area 06A is comprised of portions of the Santee River system and adjacent uplands. The Santee River extends southeast from Lake Marion and reaches the Atlantic coast in southeastern Georgetown County. The lower eighteen-mile section of the Santee River is divided into two channels known as the North Santee and South Santee Rivers. Area 06A Shellfish Management Area consists of North Santee River and its tributaries including North Santee Bay, Beach, Mosquito, Big Duck, Duck, Little Duck, Minim, Sand, Cork, Pleasant Meadow, Kinloch, Sixmile and Atchison Creeks. It also includes the South Santee River and its tributaries including Pleasant, Montgomery, and Hampton Creeks. Fourmile Creek Canal connects the two rivers. Bird Bank Creek is tributary to the Atlantic Ocean. The southern boundary of the area is the South Santee River. The U. S. Highway 17 bridges traversing the North and South Santee Rivers define the western boundary. Minim Creek Canal and portions of South and Cat Islands bound the area on the north, and the eastern boundary is the Atlantic Ocean. The existing navigable channel follows the northern route. The Santee River is connected to Winyah Bay and other coastal harbors by the AIWW, which crosses the river system approximately five miles west of the Atlantic Ocean.

Tides in Area 06A are semidiurnal, consisting of two low and two high tides occurring each lunar day. Mean tidal range in the area varies from 4.1 feet to 4.5 feet during normal tides and 4.2 feet to 5.3 feet during spring tides (Tides and Currents for Windows). Wind direction and intensity, as well as atmospheric pressure, typically result in variations of predicted tidal ranges.

In 2017, the collection of rainfall data has been improved for a more consistent, accurate, and reliable data set that can be accessed directly from a shellfish staff member's computer or phone. With assistance from the National Weather Service's, Southeastern River Forecast Center, the development of the South Carolina Shellfish Rainfall Program was introduced and

utilized. This new technology provides shellfish program staff with real-time daily updates for rainfall accumulation in each of the South Carolina shellfish growing management areas, as well as providing critical triggers that alert staff to when rainfall thresholds for closures are exceeded.

In 2019 the annual rainfall total was 34.80 inches and much lower than in 2018. Major storm events such as hurricanes have impacted the area in recent years and has caused major flooding in the area. In September of 2019, Hurricane Dorian made landfall along the South Carolina coast and produced 7.44 inches of rain during a two-day period. During September of 2018, Hurricane Florence made landfall just north of the South Carolina/North Carolina state line and produced 5.51 inches of rain during a four-day period. Hurricane Florence was a very slow-moving storm that produced extreme rainfall amounts in North Carolina which weeks later flowed south and flooded many areas within Georgetown County. The flooding caused by both of these events impacted Area 06A with an extreme amount of freshwater flushing which inundated the North and South Santee Rivers and ultimately flowed into the Atlantic Ocean. Since the shellfish season was already closed during this time no re-sampling or reopening of the harvest areas was needed.

Tropical storms and hurricanes occasionally produce extremely large amounts of rainfall. During the winter months (December through February), heavy rainfall events are uncommon, yet occasional intense thundershowers associated with rapidly moving low pressure systems generate heavy rains. Precipitation rarely occurs in the form of snow or ice. Spring weather patterns may be dynamic and intense, hail-producing thunderstorms are common. Rainfall data suggests that elevated fecal coliform levels may be more strongly associated with moderately intense localized rainfall events than with elevated river flows. Data also suggest that these impacts are relatively short-term effects.

Prevailing winds along the northern portion of the South Carolina coast are generally from the South-Southwest during the spring and summer and from the North-Northeast during autumn and winter. Surface wind speeds average 6-10 mph (South Carolina Department of Natural Resources); however strong weather systems may generate winds hurricane force winds. Tropical storms and hurricanes may be anticipated during the summer and autumn. "Northeasters", which generate high winds and heavy rains, frequently occur during late autumn and early winter months.

Historical change, described in the previous section on Hydrologic and Habitat Modification, has had major impacts on the hydrography of the Santee River delta. Rediversion and its associated increase in flow rates have resulted in a change in the salinity profile of the entire area. A 1983 publication by the United States Army Corps of Engineers predicted that rediversion would result in the salinity front to advance in Charleston Harbor and to recede in the Santee River estuary. An ongoing study conducted by the South Carolina Department of Natural Resources (formerly the South Carolina Wildlife and Marine Resources Department) found that in 1986 "during high flow period there was a "remarkable" shift in the salinity regimes of both rivers with salinity decreases downriver to near the mouth." The study stated that as of 1986, even during drought (low flow) conditions, average salinities in the lower part of the Rivers have fallen between 10 and 14 parts per thousand since rediversion. Salinity data collected by SCDHEC during routine sampling generally concur with these findings and indicate a steady decline of salinities at all sample stations subsequent to rediversion.

While the coastal areas continue to have high rainfall events, the river flooding seems to have a greater impact on the water quality in Area 06A. The Santee drainage basin extends well above Columbia and rainfall in the upper state has major effects on river flooding in Area 06A. For this review period, local rainfall events and river flooding have both had an influence upon fecal coliform levels in the area. Table 5 provides river stage and fecal coliform data for Area 06A.

Currents within Area 06A are influenced by ocean tides, winds and river flow. Under low river flow conditions, surface water movement essentially flows in an upstream direction for approximately six hours, becomes slack, and then ebbs for approximately six hours. Under high river flow conditions, surface currents move downstream throughout the entire tidal cycle.

WATER QUALITY STUDIES

DESCRIPTION OF THE PROGRAM

The Department currently utilizes a systematic random sampling (SRS) strategy within Area 06A in lieu of sampling under adverse pollution conditions. In order to comply with NSSP guidelines, a minimum of thirty samples are required to be collected and analyzed from each station during the review period. Sampling dates are computer generated prior to the beginning of each calendar year thereby insuring random selection with respect to tidal stage and weather. Day of week selection criteria is limited to Mondays, Tuesdays, and Wednesdays due to shipping requirements and laboratory manpower constraints. Sample schedules are rarely altered.

During July 1998, an updated data collection and analysis procedure was formalized. Samples utilized for classification purposes are limited to those samples collected in accordance with the SRS for a 36-month period beginning January 1 and ending December 31. This allows for a maximum of 36 samples per station yet provides a six-sample “cushion” (above the NSSP required 30 minimum) for broken samples, lab error, breakdowns, etc. This also allows each annual report to meet the NSSP Triennial Review sampling criteria.

Three hundred and forty-eight (348) water samples (<1.0 ft. deep) were collected for bacteriological analyses from ten (10) active water quality sampling stations in Area 06A during the period 01/01/17 through 12/31/19. These samples were collected for classification purposes in accordance with the Department's systematic random sampling plan. All samples were collected in 120 ml amber glass bottles, immediately placed on ice and transported by staff to the South Carolina Department of Health and Environmental Control's, Environmental Affairs, Lowcountry - Charleston laboratory in North Charleston, South Carolina. An additional 120 ml water sample was included with each shipment as a temperature control. Upon receipt at the laboratory, sample sets that exceeded a 30-hour holding time or contained a temperature control > 10 degrees C. were discarded.

Samples collected after September 1, 1986 are analyzed using the five-tube/three dilution modified A-1 method described by Nuefeld (1985).

Surface water temperatures were measured utilizing hand-held, laboratory-quality calibrated centigrade thermometers. Salinity measurements were measured in the laboratory using automatic

temperature compensated refractometers. Additional recorded field data include ambient air temperature, wind direction, tidal stage and date and time of sampling. Tidal stages were determined Nautical Software's Tides and Currents, Version 2.

MONITORING RESULTS

Stations 06A-01, 06A-01A, 06A-03, 06A-04C, 06A-05 and 06A-11 exceeded a fecal coliform MPN geometric mean value of 14.

Stations 06A-01, 06A-01A, 06A-02, 06A-03, 06-04A, 06A-04B, 06A-04C, 06A-05 and 06A-11 exceeded a fecal coliform MPN estimated 90^{th} percentile value of 43.

No station exceeded a fecal coliform geometric mean MPN value of 88.

No station exceeded a fecal coliform estimated 90^{th} percentile value of 260.

Fecal coliform data collected are summarized in Table #2. Also, included in this report is a long-range trend summary of each station with the estimated 90^{th} percentile values in correlation to annual rainfall totals (Table #3).

CONCLUSIONS

Upon review of fecal coliform bacteriological data during this review period, overall water quality within Shellfish Management Area 06A has continued to degrade during this review period. Water quality data for Station 06A-04 is the only station that meets the criteria for an Approved Classification for the upcoming shellfish harvesting season. All other stations within Area 06A will be classified as Restricted for the upcoming season.

Freshwater from rainfall, extreme weather events, and river stage seems to contribute to fecal coliform loading throughout the estuary. Freshwater flow in the North Santee Bay is substantially less than in the North and South Santee Rivers. The North Santee Bay is largely influenced by the Atlantic Ocean with higher water salinity levels which help Station 06A-04 meet an Approved Classification. Over the last few years major storms have impacted the area which has caused major flooding in rivers that increased freshwater flow into the area which causes lower salinity levels and a degradation in overall water quality within Area 06A.

RECOMMENDATIONS

Upon reviewing the shoreline survey and bacteriological data of Shellfish Management Area 06A, the following classifications are recommended**:**

Prohibited: None

Restricted:

1. All portions of the South Santee River, including all tributaries;
2. All portions of the North Santee River, including all tributaries;

3. All portions of the Intracoastal Waterway;
4. Portions of North Santee Bay upstream of Station 06A-04, including all tributaries.

Conditionally Approved: None

Approved: Those portions of North Santee Bay seaward of Station 06A-04.

Additionally, portions of Area 06A classified as Approved shall be closed to shellfish harvesting upon receipt of greater than 4.0 inches of rain within a twenty-four (24) hour period of time, as measured by the South Carolina Shellfish Rainfall Program. This methodology is associated with the concept of the Probable Maximum Precipitation (PMP) estimates for the coastal United States published in a series of hydro-meteorological reports (HMR) by the National Weather Service (National Weather Service). PMP estimates for South Carolina's growing areas are derived from HMR 51, 52, and 53 (National Research Council, 1985).

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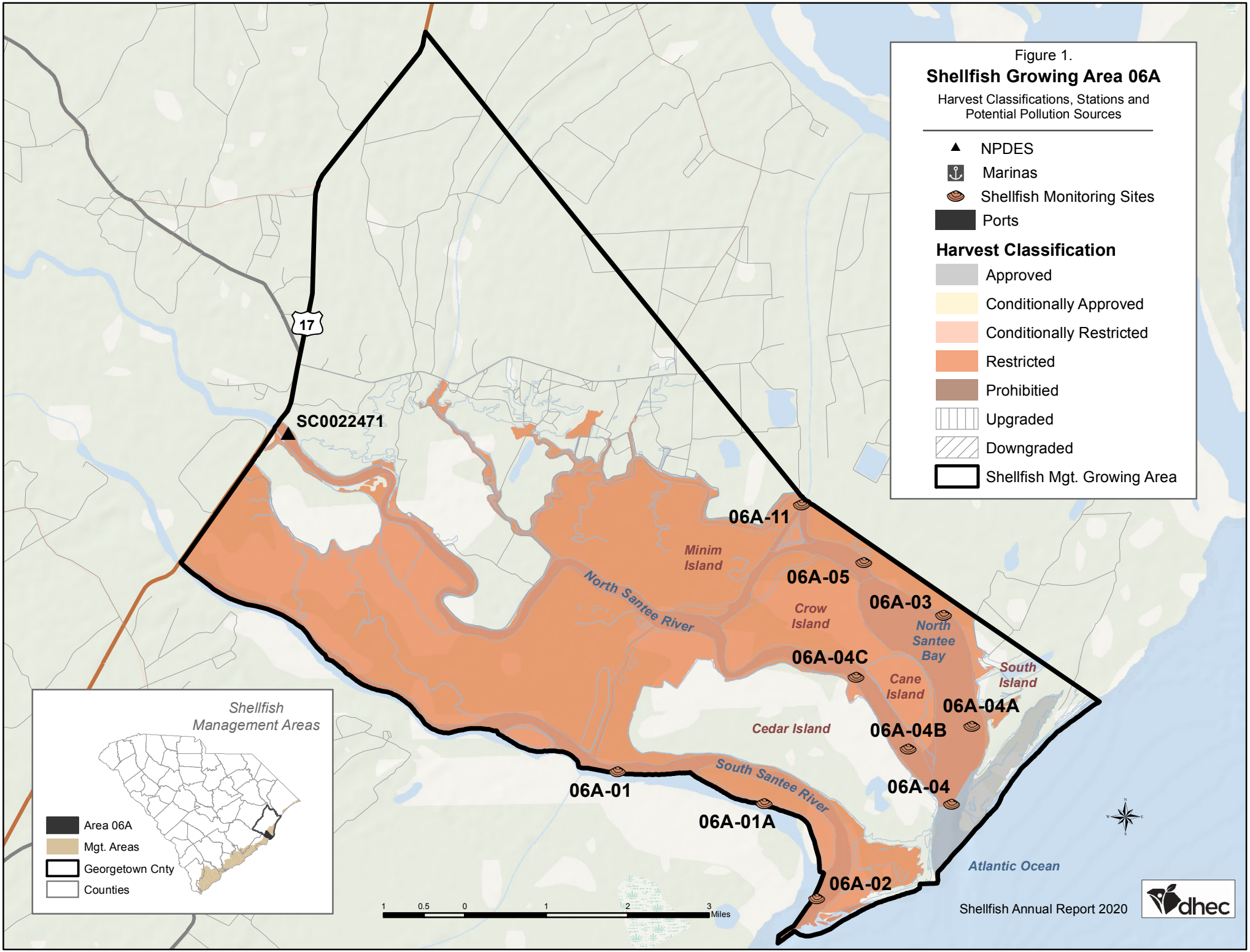
Figure 1.
Shellfish Growing Area 06A
Harvest Classifications, Stations and Potential Pollution Sources
NPDES
Marinas
Shellfish Monitoring Sites
Ports
Harvest Classification
Approved
Conditionally Approved
Conditionally Restricted
Restricted
Prohibitied
Upgraded
Downgraded
Shellfish Mgt. Growing Area
17
SC0022471
06A-11
Minim Island
North Santee River
06A-05
06A-03
Crow Island
North Santee Bay
06A-04C
Cane Island
South Island
06A-04A
Cedar Island
06A-04B
South Santee River
06A-04
06A-01
06A-01A
06A-02
Atlantic Ocean
Shellfish Management Areas
Area 06A
Mgt. Areas
Georgetown Cnty
Counties
1 0.5 0 1 2 3 Miles
Shellfish Annual Report 2020
dhec

TABLE #1

Shellfish Management Area 06A
WATER QUALITY SAMPLING STATIONS DESCRIPTION

Station	Description
06A-01	South Santee River at Alligator Creek
06A-01A	South Santee River near the midpoint of Grace Island
06A-02	South Santee Inlet
06A-03	North Santee River at Beach Creek
06A-04	North Santee Inlet
06A-04A	North Santee Bay - E of Cane Island
06A-04B	North Santee River - SW of Cane Island
06A-04C	North Santee River near the Northwestern tip of Cane Island
06A-05	North Santee River and Mosquito Creek
06A-11	Atlantic Intracoastal Waterway at Minim Creek

(Total 10)

TABLE #2

Shellfish Management Area 06A
FECAL COLIFORM BACTERIOLOGICAL DATA SUMMARY
From Shellfish Water Quality Sampling Stations between

January 01, 2017 and December 31, 2019

Station #	01	01A	02	03	04	04A	04B	04C	05	11
Samples	35	35	35	34	35	35	34	35	35	35
Geometric Mean	36.7	20.4	10.4	15.9	7.6	11	10	15.5	25.2	28.8
90th percentile	165	125	67	74	36	63	65	80	117	82
Water Quality	R	R	R	R	A	R	R	R	R	R
Classification	R	R	R	R	R	R	R	R	R	R

A - Approved **CA -** Conditionally Approved **R -** Restricted
RND - Restricted/No Depuration **P -** Prohibited

TABLE #3

Fecal Coliform Historical Trend Sheet

Area 06A Stations 90th%ile Values for Annual Updates Related to Rainfall

Station #	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009
06A-01	165	130	101	101	146	158	135	93	138	123	113
06A-01A	125	92	49	85	105	120	63	54	58	53	58
06A-02	67	74	55	69	60	65	47	34	29	23	32
06A-03	74	63	64	63	62	55	39	27	33	25	39
06A-04	36	31	30	38	45	33	20	17	16	16	16
06A-04A	63	45	44	53	52	37	14	15	17	15	14
06A-04B	65	50	29	44	59	78	46	29	20	20	24
06A-04C	80	73	51	63	77	82	55	36	32	31	35
06A-05	117	111	80	76	77	81	47	38	50	51	53
06A-11	82	92	89	85	86	102	83	65	62	65	64
Annual Rainfall (inches)	**34.80**	**53.86**	**39.34**	**58.63**	**78.32**	**55.52**	**49.4**	**28.8**	**24.1**	**50.1**	**54.1**

ND = No Data Red = Impaired Water Quality

TABLE #4

WATER QUALITY
SAMPLING STATION DATA

Shellfish Management Area 06A

Detailed data for each shellfish monitoring station listed in this report's "Fecal Coliform Bacteriological Data Summary Table" and in other shellfish reports can be obtained by writing South Carolina's Department of Health and Environmental Control – Freedom of Information office at the address below.

Freedom of Information
SC Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Any explanation or clarity needed on the report's content can be obtained by contacting preparer(s), and/or reviewer(s) listed on the cover page.

TABLE #5

RAINFALL DATA

Shellfish Management Area 06A

SOURCE:

2017 – 2019 Data
NOAA National Weather Service - Southeastern River Forecast Center
Location: Georgetown, South Carolina

2017 Annual Rainfall Summary
Source: NOAA Weather Service - Southeastern River Forecast Center
Location: Georgetown, SC

2017	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.24					0.02	0.34		0.05			
2	0.05		0.12		0.25	0.34	0.06		0.32			
3	0.1		0.03			0.5		1.38				
4	0.33			0.71			0.23	0.33				
5				1.61	0.18			0.59				
6					0.11	0.55	0.02	0.09	0.07			
7	0.2					0.68			0.97	0.1		0.24
8	0.01	0.09				1.97	0.03	0.12		0.17		0.63
9		0.14				0.08	0.38	1.1		0.02	0.04	0.51
10							0.18	0.17		0.06	0.35	
11							0.07	0.54	0.36	0.01		
12		ND	0.04					ND	2.23			
13			0.02		0.01			0.39				
14			0.35		0.83	0.19		0.04				
15								0.38	0.17			
16		0.2				0.04		ND				0.04
17							0.71	ND		0.6		
18							1.28	ND				
19						0.23	0.02	ND				
20						0.03	0.28	ND				
21						0.19		0.21				0.68
22	0.93		0.35			0.09		ND			0.36	
23	0.97				0.78	0.04		0.07				
24	0.02			0.16	1.78		0.07	0.3		0.71	0.2	
25				1.12	0.15	0.08	0.21	1.17				0.01
26						0.58						
27	0.02						0.35					0.02
28												0.01
29								0.63		0.07		0.03
30							0.68		0.1	0.13		
31			0.14					0.01				
Total	**2.87**	**0.43**	**1.05**	**3.60**	**4.09**	**5.61**	**4.91**	**7.52**	**4.27**	**1.87**	**0.95**	**2.17**

***Days highlighted indicate 4 or more inches of rain in a 24 hour period. Blank fields indicate no rainfall.**

***Sample dates are indicated in blue.**	**ND = No Data**	**ANNUAL RAINFALL**	**39.34**

2018 Annual Rainfall Summary
Source: NOAA Weather Service - Southeastern River Forecast Center
Location: Georgetown, SC

2018	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			0.24			0.02		0.09				
2							0.01	0.10			0.10	0.55
3						0.07		0.81	0.01		0.05	0.92
4	0.27						0.13	0.54				0.03
5		0.27		0.03			0.19	0.04			0.61	
6					0.20			0.07	0.23		0.03	
7			0.06				0.60	0.14			0.11	
8		0.10		0.58			0.93		0.17		0.34	0.08
9						0.75		0.60	0.02	0.04	0.01	0.89
10		0.22		0.02		0.01			0.14	0.26	0.10	0.49
11	0.01			0.05		0.05			0.18	0.41		
12	0.05	0.11	0.19			0.31		0.19	0.18			
13	0.11		0.42			0.14	0.04	0.38	0.07		0.37	
14						0.25	0.05	0.02	**0.23**			0.45
15					0.09	0.14			**1.55**		0.54	2.50
16				0.48	0.10	0.90			**1.06**		0.05	0.17
17					0.51		0.17	0.01	**2.67**	0.14		
18			0.02		0.30		0.28		0.44	0.03		
19			0.34		0.30		0.30	0.12			0.07	
20		0.02	0.29		1.54		1.15	0.05				0.09
21			0.43		0.01	0.05	2.26			0.23	0.12	0.72
22												
23	0.22			0.27			1.11	0.02				
24				1.92	0.41		0.79		0.10		0.28	
25			0.09		0.08	0.17	1.08		0.07		0.29	
26		0.16				0.06	0.63				0.03	
27				0.01			0.32		0.05	0.17	0.02	
28	0.01				0.48	0.25	0.53					0.01
29	0.73				0.92		0.01	0.39	0.33			0.64
30					0.11		3.02		0.48			0.02
31			0.15		0.05		0.61					
Total	**1.40**	**0.88**	**2.23**	**3.36**	**5.10**	**3.17**	**14.21**	**3.57**	**7.98**	**1.28**	**3.12**	**7.56**

***Days highlighted indicate 4 or more inches of rain in a 24 hour period. Blank fields indicate no rainfall.**

***Sample dates are indicated in blue.** | **ND = No Data** | **ANNUAL RAINFALL** | **53.86**

2019 Annual Rainfall Summary
Source: NOAA Weather Service - Southeastern River Forecast Center
Location: Georgetown, South Carolina

2019	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			0.01	0.04		0.66			0.14		0.03	
2			0.03	0.07			0.07	0.07	0.06			0.08
3		0.01		0.07				0.16	0.05			
4	0.02	0.09	0.28		0.09		0.28	0.19				
5	0.23		0.17	0.06	0.06	0.05	0.29	0.02	*2.34		0.01	
6			0.01	0.65	0.02	0.10	1.27	0.13	*5.10		0.07	
7						0.58		0.45				0.07
8				0.01		0.10		0.06		0.35	0.41	
9			0.02	0.09		0.31		0.09				
10			0.02	0.15		0.02	0.07	0.05				
11			0.08			0.02	0.15	0.01				
12		0.02	0.14	0.01		0.49		0.17				0.01
13		0.04		0.01	0.98	1.09	0.01				0.16	
14	0.05						0.62	0.47	0.38	0.28		0.49
15				0.06			0.27	0.44			0.17	
16		0.21				0.01		0.27		0.80	0.36	
17							0.02	0.72			0.23	
18	0.05							0.52				0.11
19				0.20			0.25	0.04				
20	0.28			0.92		0.04				0.76		
21						0.88						
22					0.08	0.12	0.01	0.02				
23					0.03	0.95	0.05				0.01	0.48
24	0.14						0.36				0.13	2.29
25	0.17	0.04				0.10		0.04				
26			0.03		0.02							
27		0.01								0.12		
28	0.02											
29				0.01				0.17				
30	0.01				0.01					0.05		0.11
31												
Total	0.97	0.42	0.79	2.35	1.29	5.52	3.72	4.09	8.07	2.36	1.58	3.64

*Days highlighted indicate 4 or more inches of rain in a 24 hour period. Blank fields indicate no rainfall.

*Sample dates are indicated in blue. ND = No Data ANNUAL RAINFALL 34.80

TABLE #6

Shellfish Management Area 06A
River Stages and Fecal Coliform Sample Results
(5-Day Previous Flows)

Source: United States Geological Survey (USGS) - Station# 02171700 - Santee River
Location: Jamestown, South Carolina

Date	River Gauge Level	06A-03	06A-04	06A-04A	06A-04B	06A-04C
01/05/2017	3.53					
01/06/2017	4.45					
01/07/2017	4.99					
01/08/2017	7.53					
01/09/2017	8.41					
01/10/2017	9.43	0	0	0	0	0
02/17/2017	2.42					
02/18/2017	1.94					
02/19/2017	1.73					
02/20/2017	2.32					
02/21/2017	2.73					
02/22/2017	3.25	22	4.5	13	13	14
03/23/2017	3.70					
03/24/2017	3.42					
03/25/2017	3.09					
03/26/2017	3.65					
03/27/2017	3.70					
03/28/2017	3.73	6.1	1.7	6.8	7.8	7.8
04/05/2017	3.80					
04/06/2017	5.08					
04/07/2017	6.31					
04/08/2017	7.13					
04/09/2017	7.16					
04/10/2017	7.64	33	13	33	N/A	13
05/17/2017	5.83					
05/18/2017	3.98					
05/19/2017	3.39					
05/20/2017	3.30					
05/21/2017	3.35					
05/22/2017	3.41	170	13	70	23	79
06/14/2017	3.42					
06/15/2017	3.09					

06/16/2017	3.30					
06/17/2017	3.09					
06/18/2017	3.18					
06/19/2017	3.30	9.2	13	7.8	1.7	13
07/13/2017	3.25					
07/14/2017	2.94					
07/15/2017	3.74					
07/16/2017	3.21					
07/17/2017	2.19					
07/18/2017	2.16	130	49	79	34	23
08/03/2017	2.06					
08/04/2017	2.02					
08/05/2017	2.04					
08/06/2017	2.20					
08/07/2017	2.76					
08/08/2017	2.95	13	2	4.5	6.8	9.2
09/22/2017	4.12					
09/23/2017	3.78					
09/24/2017	3.11					
09/25/2017	2.91					
09/26/2017	2.43					
09/27/2017	2.29	4	4.5	4.5	2	2
10/12/2017	5.15					
10/13/2017	4.36					
10/14/2017	2.87					
10/15/2017	2.78					
10/16/2017	2.81					
10/17/2017	2.32	17	1.7	1.7	4	17
10/27/2017	1.62					
10/28/2017	1.66					
10/29/2017	1.79					
10/30/2017	1.27					
10/31/2017	2.10					
11/01/2017	2.18	7.8	7.8	7.8	6.8	2
11/30/2017	4.05					
12/01/2017	3.43					
12/02/2017	4.31					
12/03/2017	4.83					
12/04/2017	5.24					
12/05/2017	5.49	4.5	2	1.7	2	17
01/11/2018	2.86					

01/12/2018	2.65					
01/13/2018	2.02					
01/14/2018	2.45					
01/15/2018	2.79					
01/16/2018	3.05	1.7	4.5	1.7	7.8	13
02/21/2018	10.36					
02/22/2018	9.94					
02/23/2018	9.36					
02/24/2018	8.48					
02/25/2018	7.36					
02/26/2018	6.53	33	21	49	70	33
03/21/2018	4.06					
03/22/2018	7.17					
03/23/2018	7.85					
03/24/2018	8.19					
03/25/2018	7.81					
03/26/2018	7.99	23	23	13	6.8	17
04/04/2018	3.74					
04/05/2018	3.54					
04/06/2018	4.56					
04/07/2018	3.19					
04/08/2018	3.08					
04/09/2018	4.40	4.5	4.5	2	2	4.5
04/26/2018	10.89					
04/27/2018	11.80					
04/28/2018	12.32					
04/29/2018	12.58					
04/30/2018	12.70					
05/01/2018	12.75	11	13	31	23	11
06/13/2018	12.19					
06/14/2018	11.64					
06/15/2018	11.01					
06/16/2018	10.26					
06/17/2018	9.11					
06/18/2018	7.85	26	2	7.8	2	7.8
07/12/2018	3.81					
07/13/2018	3.65					
07/14/2018	3.56					
07/15/2018	2.60					
07/16/2018	1.99					
07/17/2018	1.82	6.8	1.7	4.5	1.7	1.7

08/03/2018	**7.79**					
08/04/2018	**8.87**					
08/05/2018	**9.48**					
08/06/2018	**9.83**					
08/07/2018	**9.60**					
08/08/2018	**9.21**	**26**	**22**	**31**	**33**	**17**
10/10/2018	**7.28**					
10/11/2018	**8.93**					
10/12/2018	**10.29**					
10/13/2018	**11.65**					
10/14/2018	**11.78**					
10/15/2018	**11.62**	**33**	**23**	**17**	**27**	**49**
10/31/2018	**9.74**					
11/01/2018	**10.21**					
11/02/2018	**10.62**					
11/03/2018	**10.91**					
11/04/2018	**11.11**					
11/05/2018	**11.35**	**95**	**110**	**33**	**240**	**920**
11/29/2018	**14.42**					
11/30/2018	**14.03**					
12/01/2018	**13.71**					
12/02/2018	**13.55**					
12/03/2018	**13.44**					
12/04/2018	**13.32**	**33**	**33**	**49**	**49**	**46**
01/04/2019	**17.39**					
01/05/2019	**17.30**					
01/06/2019	**17.50**					
01/07/2019	**17.69**					
01/08/2019	**17.85**					
01/09/2019	**17.85**	**46**	**46**	**130**	**13**	**49**
02/15/2019	**11.27**					
02/16/2019	**11.28**					
02/17/2019	**11.28**					
02/18/2019	**11.36**					
02/19/2019	**11.47**					
02/20/2019	**11.69**	**46**	**6.1**	**21**	**21**	**33**
03/15/2019	**14.98**					
03/16/2019	**14.58**					
03/17/2019	**14.52**					
03/18/2019	**14.39**					
03/19/2019	**14.05**					

03/20/2019	13.70	11	22	11	21	33
04/11/2019	10.34					
04/12/2019	11.51					
04/13/2019	12.10					
04/14/2019	12.32					
04/15/2019	12.40					
04/16/2019	12.53	33	31	170	220	33
05/16/2019	9.34					
05/17/2019	9.25					
05/18/2019	9.13					
05/19/2019	8.63					
05/20/2019	8.08					
05/21/2019	6.81	6.8	4	4.5	1.7	6.8
05/29/2019	3.46					
05/30/2019	3.64					
05/31/2019	3.78					
06/01/2019	3.43					
06/02/2019	3.63					
06/03/2019	3.51	21	7.8	14	11	33
07/11/2019	3.74					
07/12/2019	3.02					
07/13/2019	2.30					
07/14/2019	2.35					
07/15/2019	2.81					
07/16/2019	3.06	17	1.7	4.5	78	23
08/08/2019	1.92					
08/09/2019	1.97					
08/10/2019	2.19					
08/11/2019	2.33					
08/12/2019	2.66					
08/13/2019	2.98	4.5	6.8	1.7	2	7.8
09/06/2019	3.56					
09/07/2019	3.77					
09/08/2019	3.59					
09/09/2019	3.17					
09/10/2019	2.62					
09/11/2019	2.73	17	11	33	17	13
10/18/2019	1.84					
10/19/2019	1.54					
10/20/2019	2.20					
10/21/2019	1.44					

10/22/2019	**2.08**					
10/23/2019	**1.93**	*******	**17**	**17**	**33**	**26**
10/31/2019	**2.56**					
11/01/2019	**1.43**					
11/02/2019	**1.67**					
11/03/2019	**1.62**					
11/04/2019	**1.85**					
11/05/2019	**2.20**	**4.5**	**1.7**	**1.7**	**2**	**4.5**
12/13/2019	**7.99**					
12/14/2019	**8.41**					
12/15/2019	**9.27**					
12/16/2019	**10.11**					
12/17/2019	**10.58**					
12/18/2019	**10.89**	**130**	**2**	**11**	**4.5**	**79**

*****Indicates lab error.**

TABLE #7

Shellfish Management Area 06A
Pollution Event Closures
2017-2019

Event	Date(s)	Sample Date(s)	Reopening Date	Comments
Hurricane Florence	09/14/2018-09/17/2018	N/A - Season was closed.	10/01/2018	Event produced 5.51 inches of rain during a 4-day period.
Hurricane Dorian	09/05/2019-09/06/2019	N/A - Season was closed.	10/01/2019	Event produced 7.44 inches of rain during a 2-day period.